Airport & Aircraft Safety R&D Notes

Volume 1, Issue 2 FAA's Airport & Aircraft Safety R&D Division October 1999

Risk Analysis Workshop

The National Workshop on Risk Analysis and Safety Performance Measurement in Commercial Air Transportation was held on July 20-22 at Rutgers University's Busch Campus in Piscataway, NJ. The FAA WJH Technical Center's Risk Analysis Section (AAR-424), Rutgers University, and Sandia National Laboratories jointly sponsored this workshop. The focus of this effort was primarily knowledge sharing of philosophies, approaches, models, and methodologies among Part 121 air carriers. Participants discussed their approaches to risk management and safety performance measurement. System models, hazard or threat analysis techniques, accident/incident models, and vulnerability analysis approaches were shared by members of the Commercial Aviation Community as well as by personnel from Federal Agencies, Rutgers University, and Sandia National Labs.

Workshop registrations came not only from the US but also from Canada, Bangladesh, France, Ireland, Spain, Australia, British Isles, The Netherlands, Taiwan, Sweden, Korea, and New Zealand. Attendees were from the civilian sector as well as from the military sector. The workshop speakers airlines represented numerous airlines such as United, Delta, Continental, Northwest, and Airborne Express; National Research Labs such as Sandia National Lab, Naval Research Lab, and Oak Ridge National Lab; Federal Agencies—FAA's CAMI, ICAO, and NASA Ames; and private industry—Boeing and AT&T.

Coordinators (L-R) Dr. Kathleen Diegert, Sandia, Dr. Jim Luxhoj, Rutgers, Rosanne Weiss, AAR-424, and Kathy Fazen, AAR-424

In addition to the specific topics mentioned below, Sandia Labs personnel in conjunction with Rutgers University personnel presented a primer on statistical approaches to Risk Assessment. Presenters discussed and/or demonstrated the following:

- Aviation Performance Measurement System (APMS) by NASA Ames and Battelle Labs,—Primarily an analytic tool for assessing flight operations incorporating FOQA data, although provision includes incorporating other data such as SDRs
- A Markov Model for Aviation Safety Analysis by Sandia Labs—A space-state transition model operating in the Reason Organizational Model regime

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- The British Airways Safety Information System (BASIS) by Northwest Airlines
- Maintenance Error Decision Aid (MEDA) by Boeing
- Commercial Aviation Safety Team (CAST) Analytical Approach by the AirTransport Association
- A Human Factors Approach to Accident Analysis and Prevention by CAMI and CAI
- Flight Operations Risk Analysis System (FORAS) by AT&T and the Naval Research Laboratory
- A User's Perspective on Risk Analysis by ICAO
- Application of Sequences to Risk Analysis by Oak Ridge National Labs.

Attendees were afforded an opportunity to interact with the presenters during breaks and at a 2 hour reception held the first evening. They had many favorable comments about the workshop and were supportive of similar future workshops.

Aging Aircraft Conference

On September 20-23, AAR-400 sponsored the Third Joint FAA/DOD/NASA Conference on Aging Aircraft. This year's conference, held in Albuquerque, NM, brought together over 640 world leaders in aviation safety research, aircraft design and manufacturing, fleet operation, and aviation maintenance to disseminate information on current practices and advanced technologies that will assure the continued airworthiness of aging aircraft in the commercial and military fleets.

The conference included reviews of current industry practices, assessments of future technology requirements, and the status of aviation safety research. Session topics included: Aging of Nonstructural Systems, Advanced Nondestructive Evaluation (NDE) Techniques, Bonded Repair Technology, Corrosion Monitoring and Evaluation, Health Maintenance and Engine NDE, Novel Electromagnetic Technology, Residual Strength of Fuselage Structures, and Risk Management and Methodology.

This year's conference included tours of the FAA's Airworthiness Assurance Nondestructive Inspection Validation Center. The Center, located at Sandia National Laboratories, specializes in the performance of comprehensive, independent qualitative evaluations of new and enhanced NDE, maintenance, and repair techniques developed since 1991.

The hangar facility contains several aging aircraft, large fuselage sections, and a sample structural defect library, which consists of an array of full-scale, representative sections of airframe and engine structures that contain natural or engineered defects in known locations.

For additional information on AANC, see the website:
http://www/sandia.gov/aanc/AANC.htm.

Flight Critical Digital Systems

Pete Saraceni attended a Flight Critical Digital Systems project kickoff meeting Monday, August 16 at FAA Headquarters. In attendance were the FCDS Program Sponsor, AIR-130, and representatives from the Assessment Technology Branch at the NASA Langley Research Center.

From left to right: Victor Carreno (LaRC), Wilfredo Torres (LaRC),

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(Flight Critical Digital Systems, Continued)

The project objective is to conduct a case study using the DO-XXX standard being developed by SC-180/WG-46. This standard provides guidance for design assurance and verification of complex electronic hardware such as application specific integrated circuits (ASICs), erasable programmable logic devices (EPLDs), field programmable gate arrays (FPGAs), etc. These devices are being proposed for use in flight essential and flight critical applications on all types of civil aircraft. Existing standards do not adequately address flight safety issues surrounding these advanced digital devices, which are becoming readily available to, and widely used by, the industry. DO-XXX is meant to fill the gap that existing standards do not fill; however, some real-life application of the document is needed to determine its effectiveness. It is currently unknown whether available hazard and safety assessment techniques (e.g., fault trees, Markov analysis, etc.) can be practically applied to such large-scale and highly complex advanced digital devices.

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Visit to the Air Force Research Laboratory

Earlier this year, the FAA signed a Memorandum of Understanding (MOU) with the Air Force Research Laboratory (AFRL), creating a strategic partnership that will enhance coordination and cooperation in aeronautical and aviation-related research and technology in those areas where roles and missions are complimentary.

Although the FAA and the Air Force traditionally have worked closely together in a search for common solutions to problems affecting commercial and military aviation, the MOU facilitates cooperation in key technology areas such as: aging aircraft systems; aircraft hardening; survivability and vulnerability; air vehicle subsystems technology; flight simulation; air and ground instrumentation; flight information monitoring, storage, and retrieval; air rescue and aircraft fire protection research; structures, materials, and manufacturing research; engine-related technologies; systems safety/risk analysis; flight controls; airfield pavement technologies; non-destructive inspection; weather; human factors/crew systems; and aviation security research.

Recently, to help strengthen those ties, several AARers traveled to the AFRL for a series of meetings to discuss how the agencies could further enhance their partnership. Dr. Jan Brecht-Clark (AAR-2) lead the FAA delegation and provided an overview of agency research needs and priorities. Dr. Henk Ruck, Associate Director of AFRL Plans and Programs, presented a similar overview of AFRL work. The other AAR representatives in attendance included John Fabry (AAR-430), Terry Kraus (AAR-4), and Ron Lofaro (AAR-433).

In addition to discussions on topics such as aging wiring cooperation, aging aircraft inspection, and failure analysis, AAR researchers (AAR-433's Tim Smith and Jim Newcomb, AAR-431's Dave Nesterok, and AAR-500's John Flourin) held a separate meeting to discuss the type of information needed for and the use of an aeronautical research database.

The Joint Aeronautical Commanders Group for Science and Technology, with members from the Air Force, Army, Navy, Marines, NASA, Coast Guard, and FAA, created the database to provide ready access to information on a variety of science and technology projects managed by the partner agencies. It is a relational database constructed from individual project summaries provided by each member agency. It includes project details such as: objectives, approaches, status, resources, and points of contact.

Member agencies hope the database will provide system planners with a means of assessing the availability of science and technology resources. They also hope it will provide a forum for fostering joint R&D planning, and eliminate duplication of effort.

Ohio State University Hosts COE Dedication

FAA officials joined Ohio State University (OSU) and their congressional representatives at a formal ceremony conducted at the Ohio Statehouse in Columbus to dedicate the Airworthiness Assurance Center of Excellence (AACE), now in its second year of operation. The Center, jointly managed by OSU and Iowa State University, serves as a focal point for over 100 academic and industry partners engaged in long-term safety research and development with the FAA.

Dr. Bud Baeslack, OSU Vice President for R&D, opened the ceremony stating that "partnerships - a contact sport - allow us all to achieve a greater degree of excellence."

Dr. Baeslack has worked closely with the OSU administration to establish the Center. His critical support and involvement began in 1996 during the OSU proposal preparation and submission period.

OSU's Jay Tieber spoke of AACE taking advantage of the "richness of cooperative partnerships, as the FAA provides the necessary leadership." Tieber has also been an essential player in supporting the Center during the start-up phase, working closely with the Center's Associate Director, Carol Gregorek, to assure matching fund requirements are satisfied through State contributions. Also in attendance, State Senator Charles Horn acknowledged that AACE provided an opportunity to bring about much needed closer relationships between American universities, government labs, and industry, developing and sharing technology to assure that the United States continues to be at the forefront of global competition.

Representing the Office of Aviation Research, Dr. Jan Brecht-Clark applauded the efforts of OSU and the AACE team, for their "vision, commitment, and dedication to making every act of flying safe. The list of AACE industry and academic partners looks like a Who's Who in Aviation. If each of the 50 projects now underway prevents just one accident, think of how many lives will be saved." Brecht-Clark credited the tenacity and vision of Chris Seher for the success of the COE concept. Director of the FAA's Airport & Aircraft Safety R&D Program, Seher has been involved since 1992 with three of the four Centers established by the FAA and currently serves as the organizational sponsor for the AACE and Airport Pavement Center.

Seher provided closing comments acknowledging partnerships as "the only way to go, as we push hard to leverage our R&D funds and efforts."

Nondestructive Pavement Testing

The Airport Technology R&D Branch (AAR-410) recently accepted delivery of a KUAB Two Mass Falling Weight Deflectometer (FWD). FWDs have gained wide acceptance in the highway pavement community and are becoming the preferred method for pavement response testing at our nation's airports. They are preferred over destructive methods of testing because they are much faster and do not entail the removal of pavement materials. Pavement properties are "back-calculated" from the observed dynamic response of the pavement surface to an impulse load (the falling weight). The particular FWD device purchased by AAR-410 is unique in its heavy loading capability and variable pulse width configurations and is an excellent addition to AAR-410's inventory of pavement measurement equipment.

According to the manufacturer, KUAB, in Rattvik, Sweden, the FWD is a nondestructive device used to determine the stress/strain parameters of pavements and subgrades. A specifically designed loading plate is placed on the surface of the pavement and a pulse-shaped load is applied to the plate. The load pulse is generated by the impact of a falling weight. The load pulse is designed to cause a deflection that closely simulates the deflection caused by a wheel load passing with normal load and speed.

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(Pavement Testing, Continued)

The deflection of the loaded structure is measured during loading time and the peak deflection value is recorded. When deflections are compared with the deflections of other sections, the ability of the tested pavement to bear its working load can be estimated. There can be a direct comparison with similar sections or an analytical calculation of the stresses and strains of the different courses.

The major components of the KUAB Two Mass FWD are the load generating unit, peak load transducer, deflection sensors, and the temperature and distance transducers. The recording and controlling instruments including a personal computer (PC) are installed in the tow vehicle. The FWD is typically operated from the driver's seat of the tow vehicle.

Briefs

Aircraft Rescue and Fire Fighting (ARFF) Research Program. Joe Wright and Keith Bagot (AAR-411) published an article highlighting the FAA Technical Center's Aircraft Rescue and Fire Fighting (ARFF) Research Program in Airport Technology International 2000. This is an international publication based out of London, England. The article highlighted many of the recent accomplishments of the program as well as the direction the program is headed in future research.

Protection of Oxygen Bottles. Tim Marker (AAR-422) attended an Air Transport Association (ATA) Hazardous Materials Conference held near National Airport on October 13. The FAA is committed to the development of standardized thermal protection criteria for oxygen bottle carrying cases (overpacks). Currently, the Research and Special Programs Administration (RSPA) plans to propose the standard in future rulemaking concerning the shipment of pressurized oxygen bottles in commercial airliners. During the conference, a separate meeting was held to solicit information from industry related to the protection of oxygen bottles exposed to a cargo fire.

Port Authority of New York and New Jersey. Jim White met with the Port Authority of New York and New Jersey, Eastern Regions Airport Division personnel, and the Office of Airports Safety and Standards (AAS-2) to discuss the status of the arrestor bed project for runway 22 and 13 at LaGuardia Airport, New York.

Visual Guidance Program. Don Gallagher and Paul Jones (AAR-411) attended the 70th Annual Illuminating Engineering Society of North America - Aviation Lighting Conference in New Orleans, Louisiana, October 4-7. One hundred eighty-nine engineers, consultants, manufacturers, operation and maintenance personnel, and government officials from the United States, Canada, Europe, and Australia attended the conference. Once again this meeting provided an excellent opportunity to learn and share with industry the latest technologies, issues, and regulations that effect our airport industry activities.

Center of Excellence. Dr. David Brill of the Airport Technology R&D Branch (AAR-410) attended a program review meeting for the FAA Center of Excellence (COE) in Airport Pavement Research held on October 13-14 at the University of Illinois Urbana-Champaign, Urbana, IL. Dr. Barry Dempsey, Director of the Center of Excellence and the COE principal investigators for the COE's four work areas also attended the meeting.

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(Briefs, Continued)

The four work areas are: Analysis of Denver Pavement Response; Measurement and Evaluation of Material Properties for National Airport Pavement Test Facility (NAPTF); Analyses of NAPTF Pavement Response Data; and 3D Finite Element Code Enhancement/Upgrade. Presentations covered progress made in the above four work areas during the previous six months of COE activity, as well as plans for FY-2000.

Meeting with FAA/Regulatory Support Division. John Lapointe and Larry Hackler (AAR-424) met with key personnel of the Regulatory Support Division (AFS-600) to discuss the possibility and benefits of establishing an electronic (aviation safety) information network. Initially, the network would connect the FAA with the Department of Defense/Air Mobility Command and the Department of Interior, and all three would be able to access each other's safety data. This meeting focused on data accessibility and security.

Halon Replacement. The International Halon Replacement Working Group chaired and administered by AAR-422, met in Ottawa, Canada, on October 13-14. Transport Canada Civil Aviation hosted the meeting. The purpose of the working group, which includes international industry and regulatory authority participation, is to develop performance standards for halon replacement agents used in civil aviation. AAR-422 personnel made presentations on the following subjects: cargo compartment performance standard (near completion), use of agent simulants during cargo compartment certification tests, cargo smoke and fire detector testing, engine nacelle testing and status of performance standard, use of agent simulants during engine nacelle certification tests, hand-held extinguisher testing and status of performance standard, and in-use lavatory extinguishers.

ASM Milwaukee Chapter. Mr. Bruce Fenton, the Program Manager for Propulsion and Fuels System Safety (AAR-430) was an invited speaker at a technical meeting held by the American Society for Metals - Milwaukee Chapter. Mr. Fenton made a presentation which summarized the results and plans for on-going FAA-funded safety research activities that address the problem of how to reduce fatalities due to turbine engine rotor failures. Of particular interest to the attendees was how research on advanced nondestructive inspection tools and on rotor design methods will enhance rotor integrity. Mr. Fenton also toured the facilities of the Ladish Company where a large number of titanium and nickel rotating components for turbine engines are produced.

Bigelow Receives SAE Award. On September 25, the Society of Automotive Engineers (SAE) awarded Catherine Bigelow (AAR-430) the Distinguished Probabilistic Methods Support Award for "demonstrated excellence in supporting the development of probabilistic methods technology in the FAA through the development and use of tools for aging aircraft risk assessment and extended life analysis."

In-Pavement LED Light Strip Evaluation. On August 24, AAR-411 personnel completed installation of Light Emitting Diode (LED) strip lighting adjacent to the #1 parking spot marking on the FAA ramp. This project is to determine if LED strip lighting will be an enhancement to paint markings on non-movement areas of an airport.

Airport & Aircraft Safety R&D Notes

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Special thanks to Terry Kraus, AAR-4.

Airport & Aircraft Safety R&D Notes is published electronically in January, April, July, and October. If you have any questions about this issue, or have ideas for future articles, please contact the editor, Jim Lignugaris, at (609) 485-4431 or via email at jim.lignugaris@tc.faa.gov.